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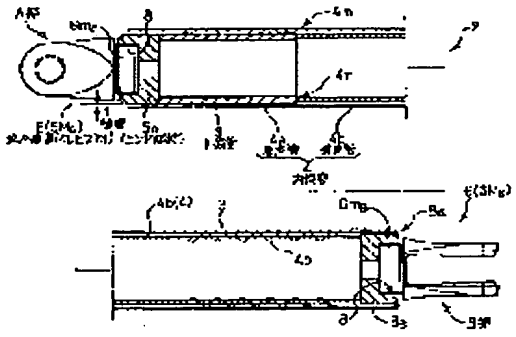
(54) DOUBLE STEEL-PIPE TYPE STRUCTURAL MATERIAL

(57)Abstract:
PROBLEM TO BE SOLVED: To realize a structure, in which a function as a double steel-pipe structural material can be brought out maximally by equalizing the axial plastic deformation of a main structural material, and to prevent the penetration of rainwater even when the structural material is used on the outdoor side.
SOLUTION: The main structural material of a double steel-pipe type structural material is formed in an internal cylindrical pipe 4, and connectors 6 enabling connection with a steel structure are installed at both end sections of the internal cylindrical pipe 4. Only a section near to one end section is formed in a thick pipe 4a in the internal cylindrical pipe 4, and a residual section on the other side connected to the thick pipe 4a is formed in a thin pipe 4b. An external cylindrical pipe 3 is formed in a thin pipe body covering the internal cylindrical pipe 4 at a slight opening (t) between the external cylindrical pipe 3 and the external surface of the thick pipe 4a. The external cylindrical pipe 3 is welded and fixed to an end member 53 placed on the thin pipe side and extended towards the other end member 5A from the outer circumference of the external cylindrical pipe 3, and selected in length covering the greater part of at least the thick pipe 4a. When the thin pipe side of the internal cylindrical pipe is arranged towards an upper section, no rainwater penetrates even when the structural material is mounted on the outdoor side, and rustproof treatment is also reduced.



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CLAIMS

[Claim(s)]
[Claim 1] In the structure material of the duplex steel pipe form where are the steel pipe structure material for [by which it is placed between the frameworks of the steel construction for forming a structural steelwork] braces, and container liner tubing is inserted into outer case tubing The junction equipment which enables connection with a structural steelwork through the end member which carried out the fixing unification of the main-structure material in which said container liner tubing receives axial tension to nothing and its both ends is formed. The residual part of the other side is formed in a thin wall tube with an outer diameter smaller than this thick wall tube. this container liner tubing -- an edge near [one's of these] -- a thick wall tube -- it is -- the thick wall tube -- reams -- said outer case tubing Few clearances are separated between the external surface of said thick wall tube, and it is a wrap light-gage shell about container liner tubing. This outer case tubing is duplex steel pipe form structure material which a welding stop is carried out to the end member located in said light-gage tubeside, and is characterized by extending towards the end member of another side from the periphery, and wrap die length selecting said the greater part of thick wall tube at least.
[Claim 2] Said junction equipment is the duplex steel pipe form structure material which is the clevis eye joined to the gusset plate attached in the structural-steelwork side, and was indicated by claim 1 characterized by screwing the clevis eye on said end member.
[Claim 3] Duplex steel pipe form structure material indicated to be **** which **** prepared in the base of the clevis eye screwed on one end member prepared in the clevis eye screwed on the end member of another side by claim 2 characterized by considering as **** of a hard flow spiral.
[Claim 4] Duplex steel pipe form structure material which is equipped with the following and characterized by the ability to make said junction bolt advance to the screw-thread hole of a node member by rotating this sleeve now and which was indicated by claim 1. Said junction equipment is a junction bolt which is screwed on the screw-thread hole of a node member attached in the structural-steelwork side, is equipped with the boss section for engagement which projects in radial at least in shank pars intermedia, and is attached in said end member. The sleeve which can carry out slide contact displacement relatively [bolt / junction], attaching in said boss section for engagement, and rotating this junction bolt
[Claim 5] Duplex steel pipe form structure material indicated by either claim 1 characterized by having prepared the ring-like projection which the side [said thick wall tube exists] jutted out over the method of outside at the member, having left the distance in which the free end of said outer case tubing chose shaft-orientations deformation at its own discretion, and having met said ring-like projection thru/or claim 4.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the duplex steel pipe form structure material for braces, forms the structure material of a duplex steel pipe form by being the steel pipe structure material by which it is placed in detail between the frameworks of the steel construction for forming a structural steelwork, and inserting container liner tubing into outer case tubing, and relates to the structural member optimal as a brace which does not start elastic buckling.
[0002]
[Description of the Prior Art] It is known that a duplex steel pipe mold structural member which is indicated by JP,4-149345,A is suitable as a structural member used for the truss which forms a structural steelwork. namely, the truth with which a structural member consists of outer case tubing and container liner tubing, and it is in a free condition about that outer case tubing tends to start and turn at elastic buckling according to the axial tension which acted from the outside and which axial tension is not delivered -- it inhibits according to the flexing-resistance force of container liner tubing in which the direct condition was maintained.
[0003] Outer case tubing of such a duplex steel pipe mold structural member is main-structure material which receives axial tension, and only the die length beforehand decided that container liner tubing can permit shaft-orientations deformation of outer case tubing rather than outer case tubing is selected short. After inserting container liner tubing in the outer case tubing, in order for container liner tubing not to carry out a location gap within outer case tubing, container liner tubing is stopped by outer case tubing by spot welding etc. by one one of the shaft orientations. And the outer-diameter dimension of container liner tubing is selected so that few clearances may remain between outer case tubing, and he is trying to prevent bending generated in outer case tubing at an as much as possible early stage.
[0004] Although it expects to carry out axial symmetry plastic deformation of the duplex steel pipe mold structural member along with container liner tubing, without carrying out elastic buckling of the outer case tubing when the very large axial compression force acts, simply, plastic buckling is not carried out to the die length of container liner tubing, but outer case tubing is bent with container liner tubing after all, and outer case tubing which has the same thickness as shaft orientations has the difficulty of being easy to generate elastic buckling.
[0005] As what improved the structural member of such a double tube type, the double pipe equipped with outer case tubing which prepared the heavy-gage tube part in both ends, and secured the light-gage tube part in the residual long center section is indicated by JP,6-346510,A. When very large axial tension acts on outer case tubing, it shows around so that a light-gage tube part may lenticulate to the method of outside along the external surface of container liner tubing, and according to this, it becomes easy to urge the axial symmetry plastic deformation whose outer case tubing shrinks with shaft orientations by it. Therefore, compression of outer case tubing is realized until the both ends of container liner tubing contact the end member prepared in the edge of outer case tubing, and generating of elastic buckling can be avoided.
[0006] Even if axial tension will be opposed and it continues receiving the large force after that according to the proof stress [proof stress / the proof stress of outer case tubing, and / of container liner tubing] of total, a structural steelwork does not collapse immediately. That is, although a structural steelwork is loose when only outer case tubing carries out plastic buckling to shaft orientations in response to

compressive force, it deforms comparatively greatly, and the external energy by an earthquake etc. is absorbed.
[0007] On the other hand, when axial tension comes to act also on container liner tubing by the contraction of outer case tubing, advance of shaft-orientations deformation of outer case tubing is suppressed, and time amount until it prevents collapse of a structural steelwork as it is also at the proof stress of the total, or it collapses is secured for a long time. If you notice the deformation in early stages of the structure by the plastic buckling of outer case tubing, improvement in the safety that the person who was present in the interior can evacuate to the outdoors within the time zone to the collapse secured based on the proof stress of total with outer case tubing and container liner tubing will be achieved.
[0008] However, outer case tubing on which axial tension acts is in the situation of being easy to generate elastic buckling according to few bending loads which enter from a part for the joint of the edge which is fixing outer case tubing, before generating shaft-orientations plastic buckling. On the other hand, in order to control generating of bending of outer case tubing, before outer case tubing begins to bend, container liner tubing controls it, but a structural member is a long picture in many cases, and among both, the remarkable clearance is left behind so that container liner tubing can be inserted in outer case tubing in fact. Therefore, when container liner tubing begins to demonstrate a function as flexing-resistance tubing, it has already turned at outer case tubing for a while, and outer case tubing is set in the condition of being easy to carry out elastic buckling.
[0009] Moreover, as described above, container liner tubing is shorter than outer case tubing at eye backlash change into the free condition of not receiving transfer of axial tension in an early phase. So, the part in which container liner tubing does not exist in the edge of outer case tubing is left behind, and when outer case tubing begins to receive bending, a container liner tube end will exert the right-angled force on outer case tubing in contact with the inside of outer case tubing at shaft orientations. By this, local bending deformation occurs in outer case tubing in the part which is not stiffened with container liner tubing, and plastic deformation uniform to shaft orientations becomes that it is hard to be guided.
[0010] The duplex steel pipe mold structural member which put outer case tubing of thin meat as stiffening tubing so that the main-structure material which receives axial tension in JP,8-68110,A might be used as container liner tubing of homogeneity thickness as an example which avoided such a thing, among these a pipe might be covered is proposed. Furthermore, the clevis eye joined to the gusset plate attached in the structural steelwork was attached in the both ends of main-structure material in one, and container liner tubing is equipped with the junction structure where it was considered so that only axial tension might be introduced as much as possible.
[0011] According to this, although the bending deformation of container liner tubing on which the force acted carries out spot welding to the central external surface of container liner tubing and is being fixed to it, it is controlled with outer case tubing in a free condition. And since axial tension is transmitted to container liner tubing through a clevis eye, it becomes only ideal axial tension to go into container liner tubing from a structural-steelwork side, and its generating of bending also decreases.
[0012] Furthermore, before cutting the padding which welded the clevis eye at the tip of container liner tubing to a perfect circle, becoming possible to bring the periphery of the padding close to the inside of outer case tubing extremely and container liner tubing's generating bending by elastic buckling, the stiffening effectiveness that outer case tubing inhibits deformation of container liner tubing is demonstrated. Since outer case tubing has covered the whole surface of container liner tubing, it forms a perfect double pipe, and in the edge of main-structure material etc., local bending deformation does not produce it.
[0013]
[Problem(s) to be Solved by the Invention] although the effectiveness expected as a duplex steel pipe mold structural member in such structure comes to be demonstrated considerably -- it -- furthermore, it waits for the appearance of the duplex steel pipe form structure material which can demonstrate powerful effectiveness. On the other hand, the following problems remain on the manufacture in the above-mentioned example of JP,8-68110,A.
[0014] In order to realize making outer case tubing as a flexing-resistance steel pipe contact container liner tubing which is main-structure material at an as much as possible early stage, the padding section which carried out welding attachment of the clevis eye is used. Therefore, in order to fix outer case tubing, maintaining a free condition to container liner tubing, one with the middle of outer case tubing is selected, it must weld to container liner tubing, or a bis-stop must be carried out. The fixed actuation in such pars

intermedia serves as cost quantity, and implementation of cheap immobilization is desired.
[0015] in addition -- if main-structure material begins to turn at a few -- spot welding -- be -- annular welding -- be -- when the force acts on a welding part, breakage of a weld zone arises, outer case tubing shifts to one side, and it may also happen to check uniform deformation of container liner tubing. Moreover, since storm sewage invades between container liner tubing and outer case tubing in using duplex steel pipe form structure material outdoors, it is necessary to give rust proofing to the confrontation section which makes a clearance. And the rust proofing is not easy and also becomes cost quantity again.
[0016] This invention is what was made in view of the above-mentioned problem. The purpose Structure where the function as duplex steel pipe form structure material can be demonstrated to the maximum extent as it becomes uniform about the shaft-orientations plastic deformation of main-structure material is made possible, The welding operation which carries out partial immobilization, maintaining a free condition after positioning outer case tubing in container liner tubing becomes simple, It is offering the duplex steel pipe form structure material [like] which does not have to make processing quality high even if it gives whether it being necessary to perform rustproofing between outer case tubing and container liner tubing by there being no invasion of storm sewage, in using it as a brace outdoors.
[0017]
[Means for Solving the Problem] This invention is steel pipe structure material for braces by which it is placed between the frameworks of the steel construction for forming a structural steelwork, and is applied to the structure material of the duplex steel pipe form where container liner tubing is inserted into outer case tubing. For the container liner tubing 4, the place by which it is characterized [the] is end member 5A which carried out the fixing unification of the main-structure material which receives axial tension to nothing and its both ends, and 5B with reference to drawing 1 . The junction equipment 6 which minds and enables connection with a structural steelwork is formed. the container liner tubing 4 -- an edge near [one's of these] -- thick-wall-tube 4a -- it is -- the thick-wall-tube 4a -- reams -- the residual part of the other side is formed in thin-wall-tube 4b with an outer diameter smaller than a thick wall tube. The outer case tubing 3 separates few clearances t between the external surface of thick-wall-tube 4a, and is a wrap light-gage shell about the container liner tubing 4. And the outer case tubing 3 is end member 5B located in a light-gage tubeside. A welding stop is carried out and it is end member 5A of another side from the periphery. It is that turn, and extend and wrap die length selects the great portion of thick-wall-tube 4a at least.
[0018] It is clevis eye 6M joined to the gusset plate 7 (see drawing 2) attached in the structural-steelwork side as junction equipment 6, and can consider as the structure where the clevis eye is screwed on the end member 5.
[0019] one side -- and member 5A Clevis eye 6MA screwed on it was prepared in the base -- ****ing -- 6mA another side -- and member 5B Clevis eye 6MB screwed on it prepared -- ****ing -- 6mB(s) It is convenient when it is **** of a hard flow spiral.
[0020] With reference to drawing 4 , it is screwed on screw-thread hole 13a of the node member 13 attached in the structural-steelwork side as junction equipment 6A. The junction bolt 11 which is equipped with 11m of boss sections for engagement which project in radial at least in shank pars intermedia, and is attached in a member 5, It has the sleeve 12 which can carry out slide contact displacement relatively [bolt / junction], attaching in 11m of the boss section for engagement, and rotating the junction bolt 11. The junction bolt 11 can be made to advance to screw-thread hole 13a of the node member 13 by rotating the sleeve now.
[0021] the side in which thick-wall-tube 4a exists -- and member 5A **** -- ring-like projection 5b (see drawing 3) jutted out over the method of outside is prepared, and it leaves the distance beta which chose shaft-orientations deformation for the free end of the outer case tubing 3 at its own discretion, and can also enable it to make ring-like projection 5b able to meet
[0022]
[Effect of the Invention] According to this invention, since it is heavy-gage, the thing with a large outer diameter for which container liner tubing is inserted in outer case tubing from a light-gage tubeside is easy, and the clearance which it leaves between the short thick wall tube and outer case tubing can be made into very few things only near [one] the edge of container liner tubing. By this, even if bending tends to occur in container liner tubing, a thick wall tube sticks to outer case tubing promptly, and prevents the bending deformation. The thin-walled part of the remainder of container liner tubing is completely covered with outer case tubing, and it will become uniform to shaft orientations by the inside of outer case tubing at

which it does not turn, the shaft-orientations plastic deformation of container liner tubing being guided.
[0023] Since the welding stop of the outer case tubing was carried out to the end member located in a light-gage tubeside and it is prolonged towards the end member of another side from the periphery, if it makes incline and arranges so that a light-gage tubeside may become a top when using this as a brace, even if it uses it outdoors, storm sewage will not invade between outer case tubing and container liner tubing. Therefore, even if rustproofing of the confrontation section of a clearance also spreads and gives needlessness, it becomes unnecessary to carry out processing quality high. Since the welding stop to the end member of outer case tubing is performed in an outer case tube end, the welding operation becomes very easy.
[0024] And if container liner tubing is used as the clevis eye joined to a gusset plate as junction equipment linked to a structural steelwork through the member, only axial tension becomes is easy to be introduced into container liner tubing which is main-structure material, and unnecessary bending can control generating **** to duplex steel pipe form structure material. If it is the structure of making a clevis eye screwing on an end member, even if while may not be in agreement with a junction hole in the gusset plate which was attached in the structural-steelwork side and which counters, a clevis eye can be half-rotated, the overall length of duplex steel pipe form structure material can be changed for every [1 of a pitch /] two, and the location of a pin hole can be doubled.
[0025] If **** prepared in the base of the clevis eye screwed on one end member and **** prepared in the clevis eye of another side are used as the hard flow spiral Even if some deviation has arisen in the distance between junction in the case of a pin joint, if duplex steel pipe form structure material is rotated, the distance between clevis eyes can be doubled with the pin hole by the side of a gusset plate, and inclusion actuation of the duplex steel pipe form structure material to a structural steelwork becomes stepless, and becomes very easy.
[0026] If it should have the junction bolt and the sleeve for junction equipment, it can be made to screw on the screw-thread hole of the node member in which the sleeve was rotated and the junction bolt was attached at the structural-steelwork side. If **** of this junction bolt will be made into the tolerance limit in the minor diameter soon, it can consider as the support gestalt approximated to the pin joint, and installation of only the axial tension to main-structure material will be attained.
[0027] If the side [a thick wall tube exists] can jut out the ring-like projection over the member at the method of outside, when container liner tubing carries out specified quantity buckling at shaft orientations, outer case tubing can contact a ring-like projection, can oppose external force as after that is also at the proof stress of total with the proof stress of container liner tubing, and it of outer case tubing, and can control rapid collapse of a structural steelwork.
[0028]
[Embodiment of the Invention] Below, the duplex steel pipe form structure material concerning this invention is explained at a detail based on the drawing in which the gestalt of the operation was shown. (a) of drawing 2 and (b) are examples of the structural steelwork 1 as a framework of steel construction, and they are adopted so that the duplex steel pipe form structure material 2 may make them placed between the frameworks as a brace. The duplex steel pipe form structure material is a duplex steel pipe with which the container liner tubing 4 is inserted in the outer case tubing 3, as shown in drawing 1 , and consideration is given so that it may become suitable as a brace especially installed in the outdoors.
[0029] If it states in detail, the container liner tubing 4 is main-structure material which receives axial tension, and is end member 5A and 5B to the both ends. Fixing unification is carried out. And the junction equipment 6 which enables connection with a structural steelwork is attached in this end member. It is clevis eye 6M and the pin joint of this junction equipment is carried out to the gusset plate 7 (see drawing 2) attached in the structural-steelwork side. In addition, they are end member 5A and 5B about the clevis eye 6MA and 6MB. Although you may make it fix, they are member 5A and 5B. It screws on the short **** hole 8 prolonged in the established shaft orientations, and is attached.
[0030] the A section of the edge where a pipe is located near [one] the edge (i.e., the left-hand side of drawing) although the duplex steel pipe form structure material 2 consists of container liner tubing 4 and outer case tubing 3 -- thick-wall-tube 4a -- becoming -- **** -- the thick wall tube -- reams -- the residual part of the other side is formed in thin meat. Thick-wall-tube 4a is made into about about 2 times [of a diameter] the die length or the die length chosen suitably of the container liner tubing 4, and is long picture most [remaining] thin-wall-tube 4b.
[0031] Although it is joined by butt welding etc. and thin-wall-tube 4b and thick-wall-tube 4a form one

container liner tubing 4, the outer-diameter dimension of thick-wall-tube 4a is larger than that of thin-wall-tube 4b. That is, in the example of illustration, the level difference of 4m has arisen on the external surface for a joint. Although the level difference of 4n exists also in an inside in this example, it does not interfere, even if it makes it the inside of thick-wall-tube 4a and thin-wall-tube 4b become flat-tapped.

[0032] The outer case tubing 3 separates few clearances t between the external surface of thick-wall-tube 4a, and serves as a wrap light-gage shell in the container liner tubing 4 between. That is, since the outer case tubing 3 is stiffening tubing as a flexing-resistance steel pipe for inhibiting bending of the container liner tubing 4, not only thin-wall-tube 4b but also the great portion of thick-wall-tube 4a must be a wrap thing. the example of drawing -- and member 5B from -- and member 5A up to -- it extended and all of thick-wall-tube 4a are covered.

[0033] End member 5A of each edge, and 5B Butt welding is carried out to the edge of thick-wall-tube 4a and thin-wall-tube 4b, it unites with it, and the **** hole 8 described above to the interior is formed, respectively. The outer case tubing 3 is the B section side located in a light-gage tubeside, and member 5B. The welding stop is carried out to perimeter 5a, and it is end member 5A of another side from the periphery. It turns, and it extends and is not fixed in the place of thick-wall-tube 4a. Therefore, clevis eye 6MA and 6MB It minds and they are member 5A and 5B. The introduced axial tension is not transmitted to the outer case tubing 3, but it sets it in the free, always no-load condition.

[0034] Since the overall length of the duplex steel pipe form structure material 2 is at most dozens of centimeters also as 3 meters, as for the above-mentioned thick-wall-tube 4a, it is easy an overall length to machine the outer diameter so that it may become what approached the bore of the outer case tubing 3 extremely. Since thin-wall-tube 4b is smaller than the path of thick-wall-tube 4a as described above, even if it is a long picture, the container liner tubing 4 can be inserted easily [the outer case tubing 3] from a light-gage tubeside.

[0035] Drawing 3 is end member 5A. It is the example prepares ring-like projection 5b jutted out over the edge for a while, leaves the distance beta which chose the shaft-orientations deformation which the free end of the outer case tubing 3 planned at its own discretion, and it was made to make meet the ring-like projection 5b. After thin-wall-tube 4b carries out shaft-orientations plastic deformation of the specified quantity, the outer case tubing 3 can contact the ring-like projection 5, and introductory axial tension can be made to oppose that after that is also at the proof stress of total with the proof stress of the container liner tubing 4, and it of the outer case tubing 3 in the case of this example now.

[0036] Drawing 4 is the example which replaced with the clevis eye and adopted junction equipment 6A of a **** type. This is several sorts of well-known junction equipments which are equipped with the junction bolt 11 and a sleeve 12, and were indicated by JP,62-55347,A, JP,63-51539,A, JP,2-18003,U, etc. If it sketches, the junction bolt 11 will be screwed on screw-thread hole 13a of the node member 13 attached in the structural-steelwork side, and will equip shank pars intermedia with 11m of boss sections for engagement which project to radial, and the opposite side will be attached in each end member 5.

[0037] A sleeve 12 is attached so that it may hang over 11m of boss sections for engagement, and it serves as a polygon cross section so that external surface can rotate with a spanner etc. And the junction bolt 11 is rotated and it has corniform through tube 12a for engagement which can carry out slide contact displacement relatively [it]. If this sleeve 12 is rotated, it advances to the junction bolt 11 towards screw-thread hole 13a of the node member 13, and when a sleeve 12 sticks to the end member 5 and the node member 13, junction actuation will complete it.

[0038] If the junction equipment 6 of drawing 1 and the pin support type by clevis eye 6M of drawing 3 is adopted, being introduced into the container liner tubing 4 becomes only axial tension from a structural steelwork ideally, and it can avoid that unnecessary bending occurs in container liner tubing. If the path of the junction bolt 11 is made thin as much as possible on the design also by the case of screw-thread type junction equipment 6A of drawing 4 , it can bring close to a pin joint condition dynamically like the case of a clevis eye.

[0039] If the large compressive force of shaft orientations acts on the container liner tubing 4 which is main-structure material through the junction equipment of clevis eye 6M grade according to the duplex steel pipe form structure material 2 of such a configuration, in the part of thin-wall-tube 4b, elastic buckling of the container liner tubing 4 tends to be carried out, and it is going to turn at it. However, since it is close so that the outer case tubing 3 contacts thick-wall-tube 4a covering a certain amount of die length, even if thick-wall-tube 4a tends to bend, it is regulated with outer case tubing. In addition, the outer case tubing 3 is fully demonstrated also by the shell of thin meat, and, as for this flexing resistance, weight

mitigation of the duplex steel pipe form structure material 2 is achieved also by existence of outer case tubing.
[0040] If still larger axial tension acts in the container liner tubing 4 with which bending was inhibited with the outer case tubing 3, plastic deformation will be caused in the part of thin-wall-tube 4b. Since thick-wall-tube 4a does not yet deform plastically at the time, as for thin-wall-tube 4b united with thick-wall-tube 4a, the Masanao nature of an axis also becomes is also easy to be maintained in response to the high effect of rigid which thick-wall-tube 4a has. Since it is such, in thin-wall-tube 4b, generating of shaft-orientations plastic deformation uniform to shaft orientations becomes easy. Even if the wave by the deformation tends to spread to the method of outside, it is prevented by the inside of the outer case tubing 3, and uneven wave-like generating of striking a big wave locally is controlled.
[0041] If the container liner tubing 4 carries out plastic buckling like a two-dot chain line and is shrunken in the duplex steel pipe form structure material 2 like drawing 1 , the edge of the outer case tubing 3 is end member 5A. Although it will exceed and clevis eye 6MA will be reached The amount of buckling distortion in the meantime will be remarkably controlled, if compared with the duplex steel pipe form structure material which structure contrary to the case of this invention on which outer case tubing is main-structure material, and container liner tubing acts as stiffening tubing does not illustrate. Therefore, even if large force, such as being based on an earthquake, acts, deformation of the structural steelwork in the phase of the plastic deformation of main-structure material is suppressed comparatively small. That is, effectiveness in which the proof stress which the container liner tubing 4 has increased substantially is demonstrated.
[0042] For example, it is member 5A like drawing 3 . There is ring-like projection 5b jutted out over the edge for a while by the method of outside. the shaft orientations of the amount beta which the free end of the outer case tubing 3 planned when the container liner tubing 4 was shrunken -- when a variation rate is carried out and it contacts ring-like projection 5b, large axial tension can be opposed as after that is also for the sum of the proof stress of the container liner tubing 4, and the proof stress of the outer case tubing 3. Anyway, since sufficient time amount to escape is securable by the time a structural steelwork collapses, those who have noticed the deformation can take evacuation action, while duplex steel pipe form structure material is straddling by large proof stress. Of course, it is not necessary to describe that such a ring-like projection can be prepared also in the end member 5 shown in drawing 4 .
[0043] Although such duplex steel pipe form structure material 2 can be used for the truss shown in (a) of drawing 2 , and (b), when using it for the brace by which it is placed between the structural steelworks 1, it becomes suitable. That is, side it is fixing the outer case tubing 3 by welding, it is member 5B. If it attaches so that it may become the bottom which inclined the edge displayed as the B section, in the example of drawing 1 , storm sewage will not invade into outer case tubing from the B section, so that it may become a top. In the lower A section, although it is suitable, it is not necessary to state the thing without invasion of storm sewage in which Clearance t existed and carried out opening between thick-wall-tube 4a and the outer case tubing 3.
[0044] So, it becomes unnecessary to carry out processing quality high even if it gives whether it is necessary to perform rustproofing to the confrontation part of the outer case tubing 3 and the container liner tubing 4. Moreover, end member 5B of the outer case tubing 3 Since welding is made by the edge part of outer case tubing, compared with the case where it sets and welds at least to pars intermedia, by the very easy activity, it can maintain the free condition of outer case tubing, and can be fixed. Reduction of the manufacture process of duplex steel pipe form structure material and facilitation of manufacture are attained generally, and cheap-ization of manufacture cost can be urged.
[0045] 6mA of **** incidentally prepared in any clevis eye, and 6mB When considering as the spiral of the same direction, if one clevis eye is half-rotated, the overall length of duplex steel pipe form structure material can be changed for every [1 of a pitch /] two. End member 5A [in / unlike this / the A section] In the screw-thread hole 8, it is clevis eye 6MA. 6mA of **** prepared in the base The gearing right-handed screw is formed. End member 5B of the B section Clevis eye 6MB screwed on Prepared **** 6mB If it considers as the left-handed screw of a hard flow spiral Clevis eye 6MA and 6MB It can realize by stepless actuation of a turnbuckle type in which the accommodation of the distance between pin holes which carries out connection support rotates duplex steel pipe form structure material, and carrying out smoothly of assembly operation is attained. Moreover, depending on the amount of bell and spigots, tension can also be beforehand given to container liner tubing now.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.

2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] Simple substance drawing of longitudinal section of the duplex steel pipe form structure material concerning this invention.
[Drawing 2] (a) is the block diagram with which duplex steel pipe form structure material is the part of an example of the structural steelwork adopted as a brace, and, as for the block diagram with which the brace has been arranged at V typeface, and (b), the brace was installed in reverse V typefaces.
[Drawing 3] Drawing of longitudinal section in the A section of the duplex steel pipe form structure material of different structure.
[Drawing 4] Drawing of longitudinal section in the A section of the duplex steel pipe form structure material which adopted screw-thread type junction equipment.
[Description of Notations]
1 [-- Container liner tubing, 4a / -- Thick wall tube,] -- A structural steelwork, 2 -- Duplex steel pipe form structure material, 3 -- Outer case tubing, 4 4b -- A thin wall tube, 5 and 5A, and 5B 6 -- and a member, 6A -- Junction equipment, 6M, 6MA, and 6MB -- A clevis eye, 6mA, and 6mB -- [-- A junction bolt, 11m / -- The boss section for engagement 12 / -- A sleeve 13 / -- A node member, 13a / -- A **** hole, t / -- Clearance.] It ****s and is 7. -- A gusset plate, 11

[Translation done.]

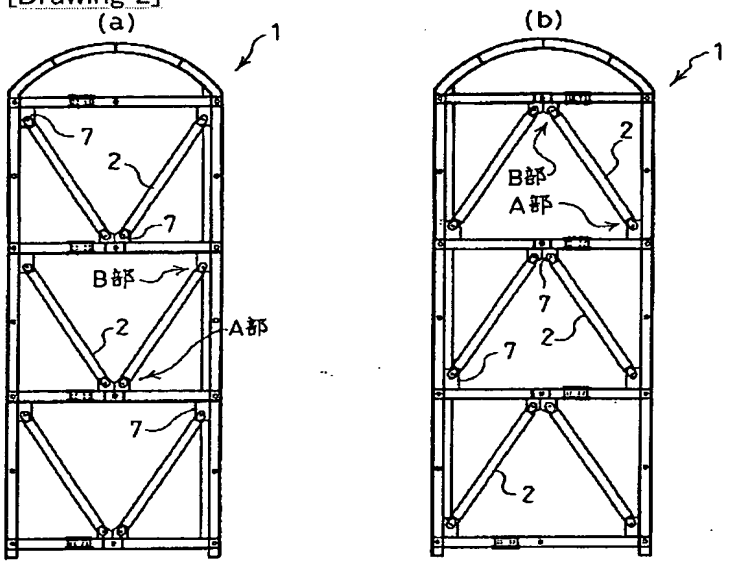
* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.

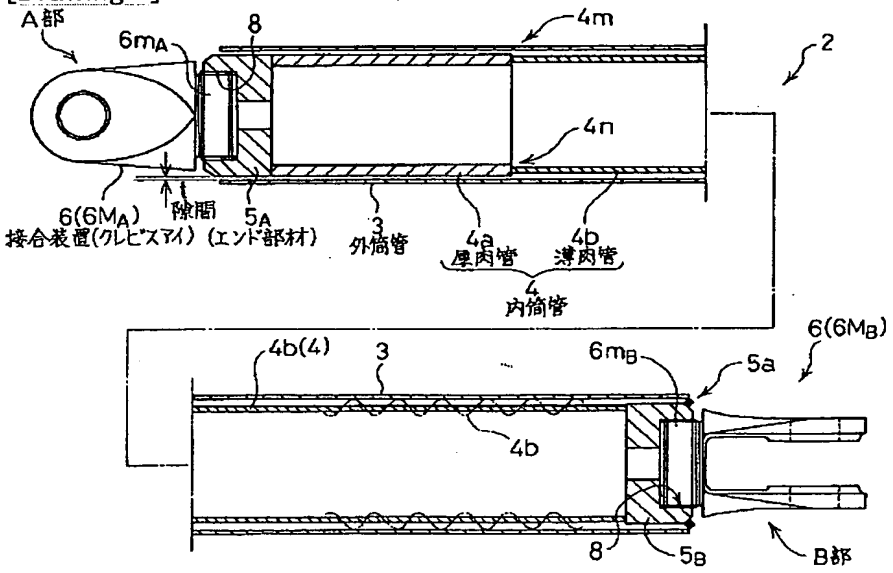
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

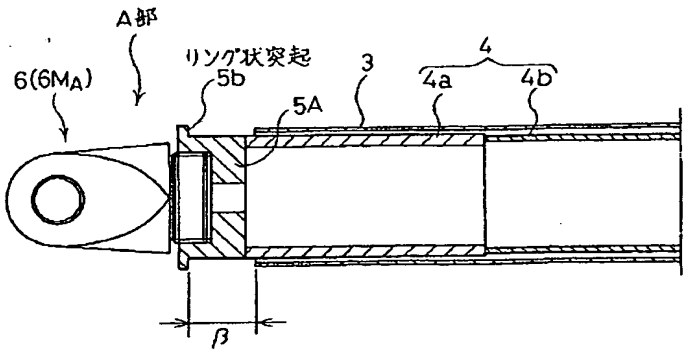
[Drawing 2]



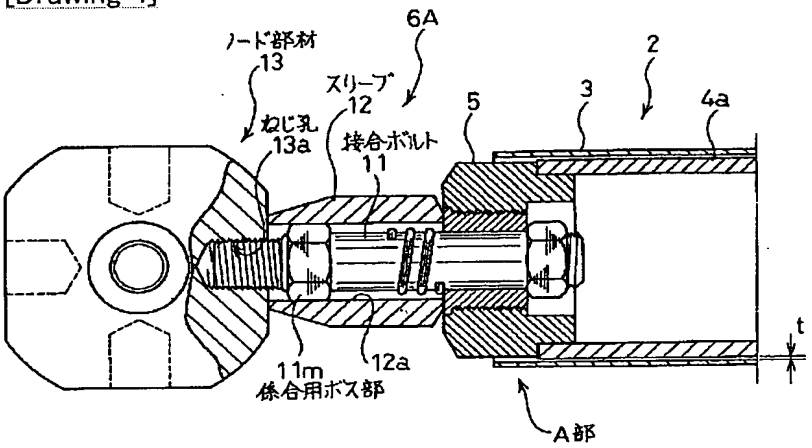
[Drawing 1]



[Drawing 3]



[Drawing 4]



[Translation done.]

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					６５１Ｄ
					６５１Ｋ

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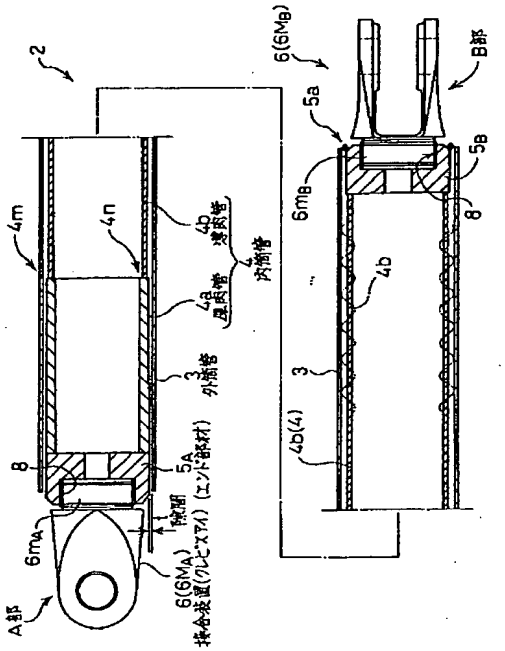
(54)【発明の名称】　二重鋼管形構造材

(57)【要約】

【課題】　主構造材の軸方向塑性変形を均一となるようにして二重鋼管形構造材としての機能を最大限に発揮できる構造を実現し、その構造材を屋外で使用しても雨水の侵入しないものとすることができること。

【解決手段】　二重鋼管形の構造材の主構造材を内筒管４とし、その両端部に鋼構造物との接続を可能にする接合装置６を設ける。内筒管４は一方の端部近傍のみが厚肉管４ａであり、その厚肉管４ａに連らなる他方側の残余部分は薄肉管４ｂに形成される。外筒管３は、厚肉管４ａの外面との間に僅かな隙間ｔを隔てて内筒管４を覆う薄肉管体である。外筒管３は薄肉管側に位置するエンド部材５Ｂに溶接止めされてその外周から他方のエンド部材５Ａに向けて延び、少なくとも厚肉管４ａの大部分を覆う長さに選定される。内筒管の薄肉管側を上となるように配置すれば、屋外に設置しても雨水の侵入はなく、防錆処理も軽減される。



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【特許請求の範囲】

【請求項１】　鋼構造物を形成するための鉄骨構造の枠組に介在されるブレース用等の鋼管構造材であって、外筒管内に内筒管が挿入されている二重鋼管形の構造材において、

前記内筒管は軸力を受ける主構造材をなし、その両端部に固着一体化したエンド部材を介して鋼構造物との接続を可能にする接合装置が設けられ、

該内筒管はその一方の端部近傍のみが厚肉管であり、その厚肉管に連らなる他方側の残余部分は該厚肉管よりも外径の小さい薄肉管に形成され、

前記外筒管は、前記厚肉管の外面との間に僅かな隙間を隔てて内筒管を覆う薄肉管体であり、

該外筒管は前記薄肉管側に位置するエンド部材に溶接止めされてその外周から他方のエンド部材に向けて延び、少なくとも前記厚肉管の大部分を覆う長さに選定されていることを特徴とする二重鋼管形構造材。

【請求項２】　前記接合装置は、鋼構造物側に取りつけられたガセットプレートに接合されるクレビスアイであって、そのクレビスアイが前記エンド部材に螺着されていることを特徴とする請求項１に記載された二重鋼管形構造材。

【請求項３】　一方のエンド部材に螺着されるクレビスアイの基部に設けられたねじが、他方のエンド部材に螺着されるクレビスアイに設けたねじとは逆方向螺旋のねじとされていることを特徴とする請求項２に記載された二重鋼管形構造材。

【請求項４】　前記接合装置は、鋼構造物側に取りつけられたノード部材のねじ孔に螺着され、軸部中間部位で半径方向に突出する係合用ボス部を備えて前記エンド部材に取りつけられる接合ボルトと、前記係合用ボス部に嵌着して該接合ボルトを回転させつつ接合ボルトに相対的に摺接変位することができるスリーブとを備え、該スリーブを回転させることによって前記接合ボルトをノード部材のねじ孔に進出させることができるようになっていることを特徴とする請求項１に記載された二重鋼管形構造材。

【請求項５】　前記厚肉管の存在する側のエンド部材には、外方に張り出したリング状突起が設けられ、前記外筒管の自由端が軸方向変形量を見計らった距離を残して前記リング状突起に対面していることを特徴とする請求項１ないし請求項４のいずれかに記載された二重鋼管形構造材。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明はブレース用二重鋼管形構造材に係り、詳しくは、鋼構造物を形成するための鉄骨構造の枠組に介在される鋼管構造材であって、外筒管内に内筒管が挿入されることにより二重鋼管形の構造材を形成して、弾性座屈を起こすことのないブレースとして最適な構造部材に関するものである。

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【０００２】

【従来の技術】鋼構造物を形成するトラスに用いられる構造部材としては、特開平４－１４９３４５号公報に記載されているような二重鋼管型構造部材が好適であることが知られている。すなわち、構造部材は外筒管と内筒管とからなり、外部から作用した軸力によって外筒管が弾性座屈を起こして曲がろうとするのを、自由状態にあって軸力の伝達されない真直な状態を維持した内筒管の曲げ抵抗力により、抑止するようになっている。

【０００３】このような二重鋼管型構造部材の外筒管は軸力を受ける主構造材であり、内筒管は外筒管の軸方向変形を許容できるように外筒管よりは予め決められた長さだけ短く選定されている。その外筒管に内筒管を挿入した後に、内筒管が外筒管内で位置ずれしないようにしておくため、軸方向のいずれかの一箇所で内筒管が外筒管に点溶接等によって止められる。そして、内筒管の外径寸法は外筒管との間で僅かの隙間が残るように選定され、外筒管に発生する曲げを可及的早期に阻止するようにしている。

【０００４】二重鋼管型構造部材は極めて大きい軸圧縮力が作用したとき、外筒管を弾性座屈させることなく内筒管に沿って軸対称塑性変形させることを期待しているが、軸方向に同じ肉厚を有する外筒管は簡単には内筒管の長さまで塑性座屈せず、結局は外筒管が内筒管と共に曲げられ、弾性座屈を発生しやすい難点がある。

【０００５】このような二重管式の構造部材を改良したものとして、特開平６－３４６５１０号公報には、両端部に厚肉管部を設けて残余の長い中央部に薄肉管部を確保した外筒管を備える二重管が開示されている。これによれば、外筒管に極めて大きい軸力が作用したとき薄肉管部が内筒管の外面に沿って外方へ波打つように案内され、それによって外筒管が軸方向に縮む軸対称塑性変形を促しやすくなる。したがって、内筒管の両端が外筒管の端部に設けたエンド部材に当接するまで外筒管の圧縮が実現され、弾性座屈の発生を回避することができる。

【０００６】その後は外筒管の耐力と内筒管の耐力との総和の耐力によって軸力に対抗することになり、大きい力を受け続けても鋼構造物は直ちに倒壊することがない。すなわち、外筒管のみが圧縮力を受けて軸方向に塑性座屈するときは鋼構造物が緩やかであるが比較的大きく変形し、地震などによる外部エネルギを吸収する。

【０００７】一方、外筒管の縮みにより内筒管にも軸力が作用するようになった時点では外筒管の軸方向変形の進行が抑えられ、その総和の耐力でもって鋼構造物の倒壊を防止したり倒壊するまでの時間を長く確保する。外筒管の塑性座屈による構造物の初期の変形に気づけば、内部にいた人は外筒管と内筒管とによる総和の耐力に基づき確保された倒壊までの時間帯のうちに、屋外へ退避することができるという安全性の向上が図られる。

【０００８】しかし、軸力の作用する外筒管は軸方向塑性座屈を発生させる前に、外筒管を固定している端部の接合部分から入る僅かな曲げ荷重により弾性座屈を発生させやすい状況にある。一方、外筒管の曲げの発生を抑制するためには、外筒管が曲がりはじめる前に内筒管がそれを抑制するようになっていなければならないが、構造部材は長尺であることが多く、実際には内筒管を外筒管に挿入することができるように両者間にはかなりの隙間が残されている。したがって、内筒管が曲げ抵抗管として機能を発揮しはじめる時点では外筒管はすでに少し曲がっており、外筒管は弾性座屈しやすい状態におかれる。

【０００９】そのうえ、上記したように、内筒管は初期の段階で軸力の伝達を受けない自由状態にしておくがために外筒管よりも短くなっている。それゆえ、外筒管の端部においては内筒管の存在しない部分が残されており、外筒管が曲げを受けはじめたとき、内筒管端が外筒管の内面に当接して外筒管には軸方向に直角な力を及ぼすことになる。これによって、内筒管により補剛されていない部分で外筒管には局部的な曲げ変形が発生し、軸方向に一様な塑性変形は誘導されがたくなる。

【００１０】このようなことを回避した例として、特開平８－６８１１０号公報に、軸力を受ける主構造材を均一厚みの内筒管とし、この内筒管を覆うように薄肉の外筒管を補剛管として被せた二重鋼管型構造部材が提案されている。さらに、主構造材の両端には、鋼構造物に取りつけられたガセットプレートに接合されるクレビスアイが一体的に取りつけられ、内筒管には可及的に軸力のみが導入されるように配慮された接合構造を備えている。

【００１１】これによれば、力が作用した内筒管の曲げ変形が、内筒管の中央外面に点溶接して固定されてはいるが自由状態にある外筒管により抑制されるようになっている。しかも、内筒管にはクレビスアイを介して軸力が伝達されるので、鋼構造物側から内筒管に入るのは理想的な軸力のみとなり、曲げの発生も少なくなる。

【００１２】ましてや、内筒管の先端にクレビスアイを溶接した肉盛りを真円に切削するなどして、その肉盛りの外周を外筒管の内面に極めて近づけることが可能となり、内筒管が弾性座屈による曲げを発生する以前に、外筒管が内筒管の変形を抑止する補剛効果を発揮する。外筒管は内筒管の全面を覆っているので完全な二重管を形成し、主構造材の端部等において局部的な曲げ変形が生じることもない。

【００１３】

【発明が解決しようとする課題】このような構造においては二重鋼管型構造部材として期待する効果がかなり発揮されるようになるが、それにもまして強力な効果を発揮させることができる二重鋼管形構造材の出現が待たれる。一方、上記した特開平８－６８１１０号公報の例における製作上に、以下のような問題が残っている。

【００１４】曲げ抵抗鋼管としての外筒管を主構造材である内筒管に可及的早期に当接させることを実現するため、クレビスアイを溶接づけした肉盛り部を利用している。そのために外筒管を内筒管に対して自由状態を維持しつつ固定するためには、外筒管の中間のある一点を選定して内筒管に溶接したりビス止めしなければならない。このような中間部における固定操作はコスト高となり、廉価な固定の実現が望まれる。

【００１５】加えて、主構造材が少し曲がりはじめるなどすると、点溶接であれ環状溶接であれ、溶接箇所に力が作用したとき溶接部の破損が生じて外筒管が一方へずれてしまい、内筒管の均一な変形を阻害することも起こり得る。また、二重鋼管形構造材を屋外で使用する場合には内筒管と外筒管との間に雨水が侵入するので、隙間をなす対面部に防錆を施す必要がある。しかも、その防錆は容易でなくまたコスト高にもなる。

【００１６】本発明は上記した問題に鑑みなされたもので、その目的は、主構造材の軸方向塑性変形を均一となるようにして二重鋼管形構造材としての機能を最大限に発揮できる構造を可能とすること、外筒管を内筒管に位置決めした後に自由状態を維持したまま部分固定する溶接作業が簡便となること、屋外でブレースとして使用する場合には雨水の侵入がなく、外筒管と内筒管との間の防錆処理を施す必要がないか施すにしても処理品質を高くしておくに及ばないような二重鋼管形構造材を提供することである。

【００１７】

【課題を解決するための手段】本発明は、鋼構造物を形成するための鉄骨構造の枠組に介在されるブレース用の鋼管構造材であって、外筒管内に内筒管が挿入されている二重鋼管形の構造材に適用される。その特徴とするところは、図１を参照して、内筒管４は軸力を受ける主構造材をなし、その両端部に固着一体化したエンド部材５$_A$，５$_B$を介して鋼構造物との接続を可能にする接合装置６が設けられる。その内筒管４はその一方の端部近傍のみが厚肉管４ａであり、その厚肉管４ａに連らなる他方側の残余部分は厚肉管よりも外径の小さい薄肉管４ｂに形成される。外筒管３は、厚肉管４ａの外面との間に僅かな隙間ｔを隔てて内筒管４を覆う薄肉管体である。そして、外筒管３は薄肉管側に位置するエンド部材５$_B$に溶接止めされてその外周から他方のエンド部材５$_A$に向けて延び、少なくとも厚肉管４ａの大部分を覆う長さに選定されていることである。

【００１８】接合装置６としては、鋼構造物側に取りつけられたガセットプレート７（図２を参照）に接合されるクレビスアイ６Ｍであって、そのクレビスアイがエンド部材５に螺着されている構造としておくことができる。

【００１９】一方のエンド部材５$_A$に螺着されるクレビ

スアイ６M_Aの基部に設けられたねじ６m_Aが、他方のエンド部材５$_B$に螺着されるクレビスアイ６M_Bに設けたねじ６m_Bとは逆方向螺旋のねじとしておくと都合がよい。

【００２０】図４を参照して、接合装置６Ａとしては、鋼構造物側に取りつけられたノード部材１３のねじ孔１３ａに螺着され、軸部中間部位で半径方向に突出する係合用ボス部１１ｍを備えてエンド部材５に取りつけられる接合ボルト１１と、その係合用ボス部１１ｍに嵌着して接合ボルト１１を回転させつつ接合ボルトに相対的に摺接変位することができるスリーブ１２とを備え、そのスリーブを回転させることによって接合ボルト１１をノード部材１３のねじ孔１３ａに進出させることができるようになっているものとしておいてもよい。

【００２１】厚肉管４ａの存在する側のエンド部材５$_A$には外方に張り出したリング状突起５ｂ（図３を参照）が設けられ、外筒管３の自由端を軸方向変形量を見計らった距離βを残してリング状突起５ｂに対面させるようにしておくこともできる。

【００２２】

【発明の効果】本発明によれば、内筒管の一方の端部近傍のみが外径の大きい厚肉であるので内筒管を薄肉管側から外筒管に挿入することが容易であり、その短い厚肉管と外筒管との間に残す隙間を極めて僅かなものにしておくことができる。これによって、内筒管に曲げが発生しようとしても厚肉管が外筒管にいち早く密着し、その曲げ変形を阻止する。内筒管の残余の薄肉部は外筒管によって完全に覆われ、曲がることのない外筒管の内面によって内筒管の軸方向塑性変形は案内されつつ軸方向に均一なものとなる。

【００２３】外筒管は薄肉管側に位置するエンド部材に溶接止めされてその外周から他方のエンド部材に向けて延びているので、これをブレースとして使用する場合に薄肉管側が上となるように傾斜させるなどして配置すれば、屋外で使用しても外筒管と内筒管との間に雨水が侵入することはない。したがって、隙間の対面部の防錆処理は不要もしく施すにしても処理品質を高くしておくに及ばなくなる。外筒管のエンド部材への溶接止めは外筒管端において行われるため、その溶接作業は極めて簡単となる。

【００２４】エンド部材を介して内筒管を鋼構造物に接続する接合装置としてガセットプレートに接合されるクレビスアイとしておけば、主構造材である内筒管には軸力のみが導入されやすくなり、二重鋼管形構造材に無用の曲げが発生するを抑制しておくことができる。クレビスアイをエンド部材に螺着させる構造としていると、鋼構造物側に取りつけられた対向するガセットプレートにおける一方の接合孔と一致しないことがあっても、クレビスアイを半回転させねじピッチの１／２ごとに二重鋼管形構造材の全長を変えることができ、ピン孔の位置を合わせることができるようになる。

【００２５】一方のエンド部材に螺着されるクレビスアイの基部に設けたねじと他方のクレビスアイに設けたねじとを逆方向螺旋としておけば、ピン接合の際に接合間距離に若干の狂いが生じていても、二重鋼管形構造材を回転させればクレビスアイ間距離をガセットプレート側のピン孔に合わせることができ、鋼構造物への二重鋼管形構造材の組み込み操作が無段階となって極めて容易になる。

【００２６】接合装置を接合ボルトとスリーブとを備えたものとしておけば、スリーブを回転して接合ボルトを鋼構造物側に取りつけられたノード部材のねじ孔に螺着させることができる。この接合ボルトのねじを許容限度に近く小径にしておけば、ピン接合に近似した支持形態とすることができ、主構造材への軸力のみの導入が可能となる。

【００２７】厚肉管の存在する側のエンド部材にリング状突起を外方に張り出せておけば、内筒管が軸方向に所定量座屈した時点で外筒管がリング状突起に当接し、その後は内筒管の耐力と外筒管のそれとの総和の耐力でもって外力に対抗し、鋼構造物の急激な倒壊を抑制することができる。

【００２８】

【発明の実施の形態】以下に、本発明に係る二重鋼管形構造材を、その実施の形態を示した図面に基づいて詳細に説明する。図２の（ａ）および（ｂ）は鉄骨構造の枠組としての鋼構造物１の一例であり、その枠組に二重鋼管形構造材２がブレースとして介在させるべく採用されている。その二重鋼管形構造材は図１に示すように外筒管３の中に内筒管４が挿入されている二重鋼管であって、とりわけ屋外に設置されるブレースとして好適となるように配慮が施されている。

【００２９】詳しく述べると、内筒管４は軸力を受ける主構造材であり、その両端部にエンド部材５$_A$，５$_B$が固着一体化されている。そして、このエンド部材には鋼構造物との接続を可能にする接合装置６が取りつけられる。この接合装置は例えばクレビスアイ６Ｍであり、鋼構造物側に取りつけられたガセットプレート７（図２を参照）にピン接合されるものである。なお、そのクレビスアイ６M_A，６M_Bをエンド部材５$_A$，５$_B$に固着させてもよいが、エンド部材５$_A$，５$_B$に設けた軸方向に延びる短いねじ孔８に螺着して取りつけられている。

【００３０】二重鋼管形構造材２は内筒管４と外筒管３とからなるが、その内筒管は一方の端部近傍すなわち図の左側に位置する端のＡ部のみが厚肉管４ａとなっていて、その厚肉管に連らなる他方側の残余部分は薄肉に形成されている。厚肉管４ａは例えば内筒管４の直径の約二倍程度の長さもしくは適宜選択された長さとされ、残りの大部分が長尺な薄肉管４ｂである。

【００３１】薄肉管４ｂと厚肉管４ａとは突き合わせ溶

接等により接合され一本の内筒管４を形成するが、厚肉管４ａの外径寸法は薄肉管４ｂのそれよりも大きくなっている。すなわち、図示の例では接合部分の外面に段差４ｍが生じている。この例では内面にも段差４ｎが存在するが、厚肉管４ａと薄肉管４ｂの内面が面一となるようにしておいても差し支えない。

【００３２】外筒管３は、厚肉管４ａの外面との間に僅かな隙間ｔを隔てて内筒管４を覆う薄肉管体となっている。すなわち、外筒管３は内筒管４の曲げを抑止するための曲げ抵抗鋼管としての補剛管であるので、薄肉管４ｂはもとより厚肉管４ａの大部分を覆うものでなければならない。図の例ではエンド部材５Ｂからエンド部材５Ａまで延び、厚肉管４ａの全てを被覆している。

【００３３】各端のエンド部材５Ａ，５Ｂは厚肉管４ａおよび薄肉管４ｂの端部に突き合わせ溶接して一体化され、その内部に上記したねじ孔８がそれぞれ形成される。外筒管３は薄肉管側に位置するＢ部側のエンド部材５Ｂの周囲５ａに溶接止めされており、その外周から他方のエンド部材５Ａに向けて延び、厚肉管４ａのところでは固定されることがない。したがって、クレビスアイ６ＭＡ，６ＭＢを介してエンド部材５Ａ，５Ｂに導入された軸力は外筒管３に伝達されず、それが常に無負荷な自由な状態におかれる。

【００３４】上記の厚肉管４ａは二重鋼管形構造材２の全長が３メートルとしても高々数十センチメートルであるので、その外径を外筒管３の内径に極めて近接したものとなるように機械加工しておくことは容易である。薄肉管４ｂは前記したように厚肉管４ａの径より小さいので、それが長尺であっても内筒管４を薄肉管側から外筒管３に簡単に挿入することができる。

【００３５】図３は、エンド部材５Ａの端に少し張り出されたリング状突起５ｂを設け、外筒管３の自由端が予定した軸方向変形量を見計らった距離βを残してそのリング状突起５ｂに対面させるようにした例である。この例の場合は、薄肉管４ｂが所定量の軸方向塑性変形をした後に外筒管３がリング状突起５に当接し、その後は内筒管４の耐力と外筒管３のそれとの総和の耐力でもって、導入軸力に対抗させることができるようになっている。

【００３６】図４はクレビスアイに代えて、ねじ式の接合装置６Ａを採用した例である。これは、接合ボルト１１とスリーブ１２とを備えるもので、特開昭６２－５５３４７号公報、特開昭６３－５１５３９号公報や実開平２－１８００３号公報等に記載された幾種かの公知の接合装置である。略述すれば、接合ボルト１１は、鋼構造物側に取りつけられたノード部材１３のねじ孔１３ａに螺着されるもので、軸部中間部位には半径方向へ突出する係合用ボス部１１ｍを備えており、その反対側はそれぞれのエンド部材５に取りつけられる。

【００３７】スリーブ１２は係合用ボス部１１ｍに被さるように嵌着され、外面がスパナ等で回転することができるように多角形断面となっている。そして、接合ボルト１１を回転させかつそれと相対的に摺接変位することができるような係合用の角状貫通孔１２ａを有している。このスリーブ１２を回転させれば、接合ボルト１１はノード部材１３のねじ孔１３ａに向けて進出され、スリーブ１２がエンド部材５とノード部材１３とに密着した時点で接合操作が完了する。

【００３８】図１および図３のクレビスアイ６Ｍによるピン支持式の接合装置６を採用しておけば、鋼構造物から内筒管４に導入されるのは理想的に軸力のみとなり、内筒管に無用の曲げが発生するのを回避しておくことができる。図４のねじ式接合装置６Ａの場合でも接合ボルト１１の径を設計上可及的に細くしておけば、クレビスアイの場合と同様に力学的にはピン接合状態に近づけることができる。

【００３９】このような構成の二重鋼管形構造材２によれば、主構造材である内筒管４にクレビスアイ６Ｍ等の接合装置を介して軸方向の大きい圧縮力が作用すると、内筒管４は薄肉管４ｂの部分で弾性座屈して曲がろうとする。しかし、外筒管３が厚肉管４ａにある程度の長さにわたって接触するほどに近接しているので、厚肉管４ａが曲がろうとしても外筒管によって規制される。なお、この曲げ抵抗は外筒管３が薄肉の管体でも十分に発揮され、外筒管の存在によっても二重鋼管形構造材２の重量軽減が図られる。

【００４０】外筒管３によって曲げの抑止された内筒管４においてさらに大きい軸力が作用すると、薄肉管４ｂの部分で塑性変形を起こす。その時点では厚肉管４ａがいまだ塑性変形することはないので、厚肉管４ａに一体化された薄肉管４ｂは厚肉管４ａの有する高い剛性の影響を受けて軸線の真直性も保たれやすくなる。このようなことから、薄肉管４ｂでは軸方向に均一な軸方向塑性変形の発生が容易となる。その変形による波が外方へ広がろうとしても外筒管３の内面で阻止され、局部的に大きな波を打つといった不均一な波形の発生は抑制される。

【００４１】図１のごとき二重鋼管形構造材２においては、内筒管４が二点鎖線のように塑性座屈して縮むと外筒管３の端部はエンド部材５Ａを越えてクレビスアイ６ＭＡに到達することになるが、その間の座屈変形量は、外筒管が主構造材であり内筒管が補剛管として作用するような本発明の場合とは逆の構造の図示しない二重鋼管形構造材に比べれば、著しく抑制される。したがって、地震による等の大きい力が作用しても、主構造材の塑性変形の段階での鋼構造物の変形は比較的小さく抑えられる。すなわち、内筒管４の有する耐力は実質的にあたかも増大したような効果が発揮される。

【００４２】例えば図３のように、エンド部材５Ａの端に少し外方に張り出されたリング状突起５ｂがあって、

内筒管４が縮むことによって外筒管３の自由端が予定した量βの軸方向変位をしたときリング状突起５ｂに当接するようになっている場合には、その後は内筒管４の耐力と外筒管３の耐力との和でもって、大きい軸力に対抗することができる。いずれにしても鋼構造物が倒壊するまでには逃げ出すに十分な時間を確保できるので、その変形に気づいた人は、大きい耐力で二重鋼管形構造材が踏ん張っている間に退避行動をとることができる。もちろん、このようなリング状突起を図４に示したエンド部材５にも設けることができるのは述べるまでもない。

【００４３】このような二重鋼管形構造材２は図２の（ａ）や（ｂ）に示した梁材等に使用することができるが、その鋼構造物１に介在されるブレースに使用する場合に好適となる。すなわち、外筒管３を溶接にて固定している側のエンド部材５$_B$が上となるように、図１の例ではＢ部と表示された端部を傾斜した上側となるように取りつければ、Ｂ部から雨水が外筒管の中へ侵入することはない。下のＡ部では厚肉管４ａと外筒管３との間に隙間ｔが存在して開口した恰好となっているが、雨水の侵入のないことは述べるまでもない。

【００４４】それゆえに、外筒管３と内筒管４との対面部分に防錆処理を施す必要がないか施すにしても処理品質を高くしておくに及ばなくなる。また、外筒管３のエンド部材５$_B$への溶接は外筒管の端部位でなされるので、中間部位において溶接する場合に比べて極めて簡単な作業で外筒管の自由状態を維持して固定することができる。総じて二重鋼管形構造材の製作工程の低減や製造の簡便化が図られ、製作コストの低廉化を促すことができる。

【００４５】ちなみに、いずれのクレビスアイにも設けられるねじ６ｍ$_A$，６ｍ$_B$を同じ方向の螺旋とする場合＊には、一方のクレビスアイを半回転させればねじピッチの１／２ごとに二重鋼管形構造材の全長を変えることができる。これとは異なり、Ａ部におけるエンド部材５$_A$のねじ孔８にはクレビスアイ６Ｍ$_A$の基部に設けたねじ６ｍ$_A$に噛みあう例えば右ねじを形成しておき、Ｂ部のエンド部材５$_B$に螺着されるクレビスアイ６Ｍ$_B$に設けたねじ６ｍ$_B$を逆方向螺旋の左ねじとしておけば、クレビスアイ６Ｍ$_A$，６Ｍ$_B$を連結支持するピン孔間距離の調節作業が二重鋼管形構造材を回転させるだけのターンバックル式の無段階操作で実現でき、組立作業の円滑化が図られる。また、そのねじ込み量によっては、内筒管に予張力を与えておくこともできるようになる。

【図面の簡単な説明】

【図１】　本発明に係る二重鋼管形構造材の単体縦断面図。

【図２】　二重鋼管形構造材がブレースとして採用された鋼構造物の一例の部分であって、（ａ）はブレースがＶ字形に配置された構成図、（ｂ）はブレースが逆Ｖ字形に設置された構成図。

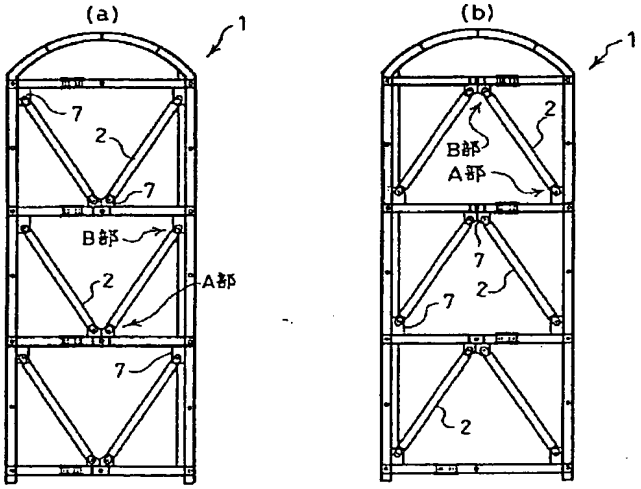
【図３】　異なる構造の二重鋼管形構造材のＡ部における縦断面図。

【図４】　ねじ式接合装置を採用した二重鋼管形構造材のＡ部における縦断面図。

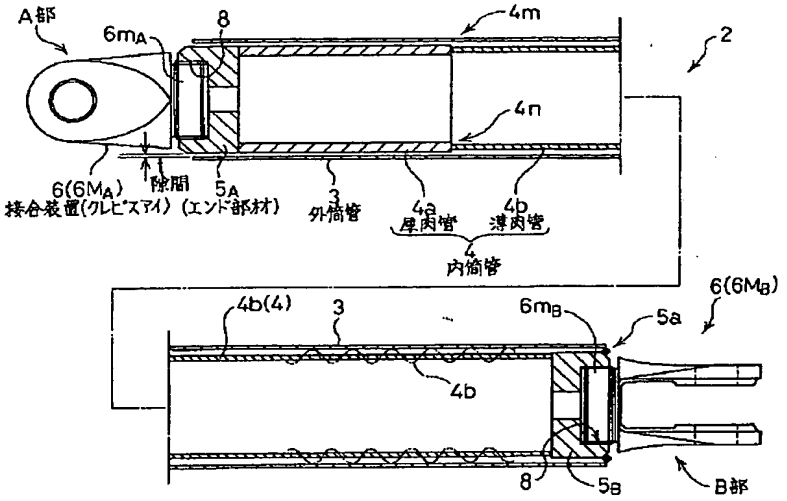
【符号の説明】

１…鋼構造物、２…二重鋼管形構造材、３…外筒管、４…内筒管、４ａ…厚肉管、４ｂ…薄肉管、５，５$_A$，５$_B$…エンド部材、６，６Ａ…接合装置、６Ｍ，６Ｍ$_A$，６Ｍ$_B$…クレビスアイ、６ｍ$_A$，６ｍ$_B$…ねじ、７…ガセットプレート、１１…接合ボルト、１１ｍ…係合用ボス部、１２…スリーブ、１３…ノード部材、１３ａ…ねじ孔、ｔ…隙間。

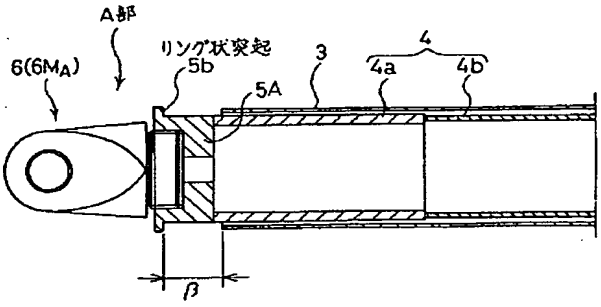
【図２】



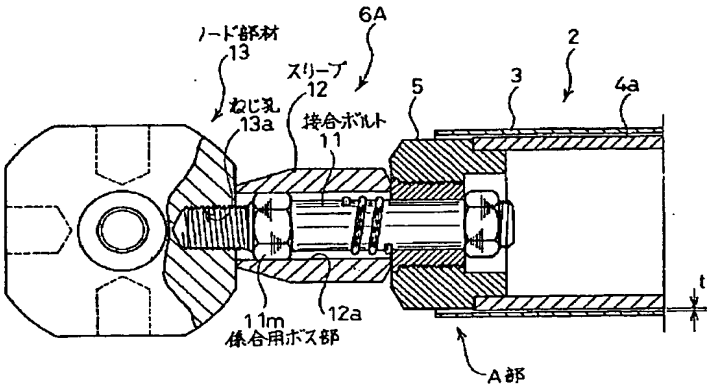
【図１】


A部
6mA
8
4m
2
4n
6(6MA)
接合装置(クレビスアイ)
除間
5A
(エンド部材)
3
外筒管
4a
厚肉管
4b
薄肉管
4
内筒管
6(6MB)
4b(4)
3
6mB
5a
4b
8
5B
B部

【図３】


A部
6(6MA)
リング状突起
5b
5A
3
4
4a
4b
β

【図４】


ハード部材
13
6A
スリーブ
12
ねじ込
13a
接合ボルト
11
5
3
2
4a
t
11m
接合用ボス部
12a
A部

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